Xantrex Prosine 2.0 Inverter/Charger

Joe Schwartz

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Application: **I installed a Prosine 2.0 inverter/charger in an off-grid, residential system at *Home Power* Central. It powers standard, 120 VAC household loads including lighting, audio and video equipment, a refrigerator, circulation pumps for a solar hot water system, and small power tools. During the winter months, it's frequently used in conjunction with an engine generator to recharge the battery bank during extended cloudy periods.**

System: **The system is located in southern Oregon. Major components include a 1.4 KW (rated) PV array, four Surrette 6-CS-25PS flooded lead-acid batteries (1,640 AH at 12 VDC), and a Honda ES6500 (6,500 watt) gasoline generator.**

The Xantrex Prosine 2.0 is a great 12 volt sine wave inverter for boat, RV, or small residential systems. Its integrated AC charger is perfect for shore power or generator backup.

The Prosine 2.0 was designed for mobile and marine inverter applications, but it's also suitable for small off-grid systems that aren't rolling down the road, and for utility backup systems.

Whether your home is in motion or not, there are three major inverter design characteristics that you'll want in most cases: high quality AC output, an efficient battery charger, and the ability to install the inverter in a safe, code-compliant fashion. The Prosine 2.0 has all three of these characteristics covered.

Waveform

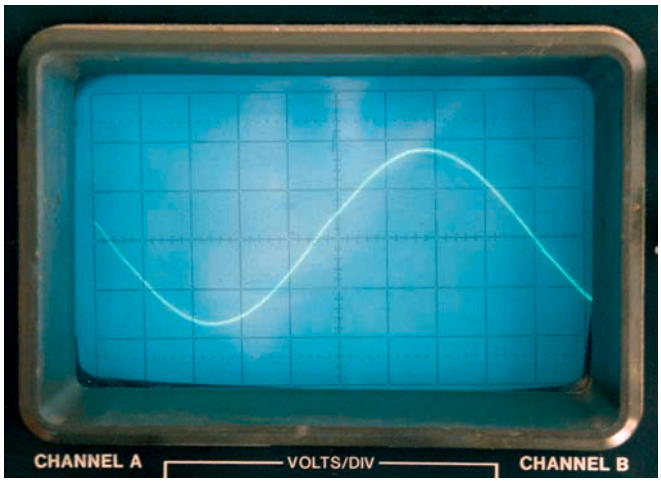
In virtually all new residential installations, modified square wave inverters are a thing of the past. Their less-than-ideal AC output waveform often results in noise on audio and video equipment, hot and inefficient motor operation, unsatisfactory operation of tools with variable speed controls, and damage to some AC appliances.

On the other end of the spectrum are high quality sine wave inverters, like the Prosine 2.0. The AC power quality of the Prosine is excellent. In fact, its output has higher power quality than the utility grid in most cases.

Battery Charger

Most off-grid systems have an engine generator to charge the battery bank during extended cloudy periods. Anyone who has spent time living with a generator knows that they are expensive to run and maintain, and that not much detracts more from the great outdoors than a roaring generator. When you do need to use the generator, high quality chargers will minimize the run time and get you through the charging process as quickly, painlessly, and inexpensively as possible.

The Prosine 2.0 has an efficient battery charger with a high power factor (1.0 throughout our testing). Power factor is a ratio of the AC power actually used by a load (real power, the battery charger in this case) compared to the total power delivered (apparent power). With high power factor devices, the load uses most or all of the power delivered by the source. Low power factor appliances reflect some of the delivered power back at the source. The higher the power



The Prosine's AC waveform is cleaner than most utility power.

Test Equipment & Setup

Inverter test data was collected while adding incremental AC resistive loads to the inverter. Charger data was collected over a complete charge cycle. Battery voltage, battery current (via a 50 mV/500 A shunt), and peak and rms AC voltage were measured using three Fluke 87 digital multimeters. AC amperage was measured with a Brand Electronics model 20-1850 power meter and a Fluke 43B AC Power Quality Analyzer. The Fluke 43B was also used to measure total harmonic distortion and power factor. The battery temperature during testing was 70.9°F (21.6°C). The inverter setting for AC breaker size was set at 20 A.

Prosine 2.0 Inverter Test

AC Out					DC In			
Load Watts	Volts (Peak)	Volts (rms)	Amps	THD*	Watts	Volts	Amps	Efficiency
Search	NA	NA	NA	NA	1.3	12.99	0.1	NA
Idle	164.8	117.8	0.0	1.1%	22.0	12.97	1.7	NA
21.2	164.8	117.8	0.2	1.0%	47.2	12.75	3.7	44.9%
42.4	164.8	117.8	0.4	1.0%	71.4	12.75	5.6	59.4%
63.6	164.8	117.8	0.5	1.0%	96.8	12.74	7.6	65.7%
86.0	165.2	117.8	0.7	1.2%	119.7	12.73	9.4	71.9%
168.3	165.2	117.7	1.4	1.1%	207.3	12.72	16.3	81.2%
255.0	164.4	117.5	2.2	1.0%	300.3	12.67	23.7	84.9%
338.1	164.4	117.4	2.9	1.0%	391.2	12.62	31.0	86.4%
493.4	164.4	117.2	4.2	1.0%	562.3	12.58	44.7	87.7%
579.6	164.0	117.1	5.0	1.1%	656.3	12.50	52.5	88.3%
663.4	163.6	117.0	5.7	1.1%	748.9	12.44	60.2	88.6%
748.2	163.6	116.9	6.4	1.1%	843.2	12.40	68.0	88.7%
819.9	163.6	116.8	7.0	1.0%	935.2	12.37	75.6	87.7%
981.8	163.6	116.6	8.4	1.1%	1,110.8	12.37	89.8	88.4%
1,230.5	162.8	116.3	10.6	1.1%	1,387.9	12.25	113.3	88.7%
1,365.3	163.2	116.1	11.8	1.1%	1,544.5	12.19	126.7	88.4%
1,601.5	162.0	115.8	13.8	1.1%	1,802.9	12.10	149.0	88.8%
1,846.4	162.0	115.4	16.0	1.1%	2,080.0	12.03	172.9	88.8%
2,101.7	160.8	115.1	18.3	1.1%	2,364.5	11.96	197.7	88.9%

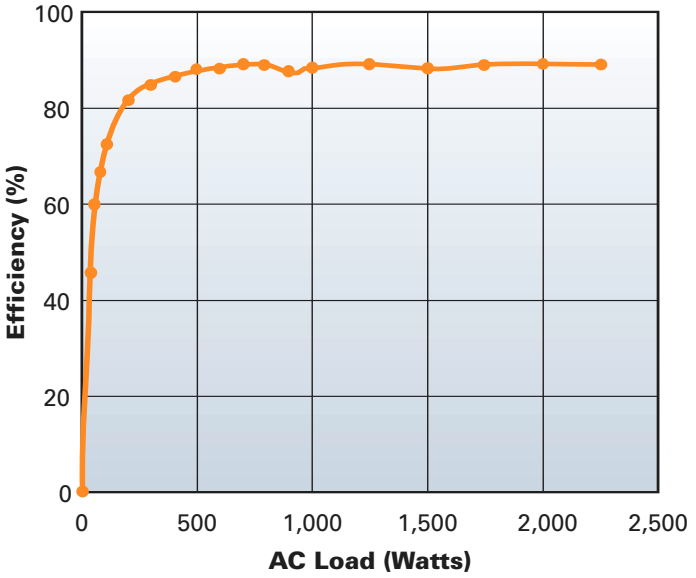
*Total harmonic distortion

factor, the better. A unity power factor, represented numerically as 1.0, means that all the power supplied to the appliance is used by the appliance to do work, and none is reflected back to the source. The result is more efficient operation of the AC source, and in this case, less generator run time.

Installation

Inverters should be installed in cool, dry locations. Because the Prosine 2.0 was designed for mobile and marine markets, it's not available in a preassembled power panel that includes AC and DC enclosures and disconnects. But if you purchase an optional DC conduit box from the manufacturer, the inverter can easily be installed to meet all the requirements of the *National Electrical Code (NEC)*. The inverter is straightforward to install and relatively easy to program. The 164 page installation and operation manual will guide you through the process if you're installing the inverter on your own.

Prosine 2.0 Inverter Efficiency



Features

High Points:

- Excellent power quality (< 2% THD)
- DC charger with 1.0 power factor
- User-friendly control panel that can be remote mounted
- 16 VDC high battery voltage input limit
- Auto restart after error conditions end
- Detailed installation and user's manual
- Quiet operation

Low Points:

- 30 A transfer switch limits battery charging under some conditions
- Tight AC wiring compartment
- No off-the-shelf, power panel mounted options

List Price: US$2,199

Warranty: 2 years

Other:

- Two units can be series stacked for 120/240 VAC output
- 15 amp GFCI receptacle option for AC output in mobile applications

Applications

The Prosine 2.0 is well suited for a variety of applications—some more so than others. Here are some of my quick observations about this equipment's adaptability.

Boats and RVs. If you're a boater or RVer, the Prosine 2.0 is a great choice. Built for these markets, the inverter is designed to operate seamlessly between stand-alone and shore-powered use.

In a residential application, the neutral wiring system is routinely bonded or connected to the equipment ground wiring system by placing a jumper between the ground and neutral bus bars located inside the main load center or breaker panel. The neutral system should only be bonded or connected to the equipment ground system in one place. This reduces the shock hazard by creating a single electrical path to ground.

In mobile applications, AC power from a marina or RV park (sometimes referred to as "shore power") is often used to supplement the vehicle or boat's onboard power system. The shore power system's neutral conductor is already bonded to the stationary equipment ground system. Connecting to this system creates a secondary neutral bond if the vehicle's onboard power system already has a fixed neutral-to-ground bond inside a breaker panel.

To eliminate this problem, the Prosine 2.0's transfer relay opens (disconnects) an internal neutral-to-ground bond when it's connected to shore power. In stand-alone use, the transfer relay closes (connects) this internal neutral-to-ground bond, effectively connecting the inverter's neutral output conductor to the vehicle's equipment ground system. If you're planning to use the inverter in a stationary residential application, you can easily disable this automatic neutral-to-ground bond feature by relocating a small bonding screw in the inverter's AC wiring compartment, and make a permanent neutral-to-ground bond in the AC mains panel. The manual explains this process thoroughly.

Utility backup. The Prosine 2.0 is also well suited for grid backup power systems. The inverter is not designed

Prosine 2.0 Charger Test

DC Out			AC In (from Generator)						
Volts	Amps	Watts	Volts (Peak)	Volts (rms)	Amps	Watts	Freq. (Hz)	Load* (Watts)	Efficiency
13.67	106.3	1,453.1	170.0	120.7	14.04	1,694.6	60.4	None	85.7%
14.14	105.0	1,484.7	170.8	120.9	14.32	1,731.3	60.9	None	85.8%
14.62	82.0	1,198.8	169.2	122.5	11.47	1,405.1	62.4	None	85.3%
14.75	63.0	929.3	169.2	123.3	8.83	1,088.7	61.7	None	85.4%
13.57	74.1	1,005.5	170.0	120.9	14.63	1,768.8	60.4	583	84.8%
13.49	59.3	800.0	169.2	120.8	14.88	1,797.5	60.4	861	85.4%
13.33	26.3	350.6	168.4	120.3	15.39	1,851.4	60.0	1,424	82.0%

*Additional resistive load

Tech Specs

Inverter

- Continuous output power: 2 KW at 40°C (104°F)
- Surge rating (5 second): 4.5 KW
- True sine wave AC output: <2 percent THD typical
- Efficiency (full load): 87 percent
- Peak efficiency: 89 percent
- No load power draw (inverting): <25 W
- No load power draw (search mode, 3 sec. interval): <2 W
- Input DC voltage range: 10 to 16 VDC
- Transfer time (backup AC to inverter and inverter to backup AC): 16 milliseconds typical

Charger

- 100 A DC continuous output current
- Three-stage DC charge control with manual equalize
- Temperature compensated charging via remote battery sensor
- Average efficiency 81 percent
- AC input power factor 0.99
- Input AC voltage range 90 to 135 VAC

Physical Size: 17 3/4 by 11 3/8 by 5 3/4 inches (45 x 29 x 15 cm)

Weight: 24 pounds (11 kg)

Note: All specifications supplied by manufacturer.

to sell electricity to the utility, but it does have an internal transfer switch that allows it to automatically power select loads in the event of a utility failure. The transfer time between grid and inverter power is 16 milliseconds. This may or may not be fast enough to keep computers from crashing. Make sure to contact the manufacturer of your computer and double-check the required transfer time before purchasing any inverter for this use.

Residential. The Prosine 2.0 is not the most versatile inverter for use in off-grid systems, since only one input voltage is available—12 VDC. Twelve volt systems are standard in the RV market because the vehicle's alternator is often used to charge the coach batteries while you're rolling down the road. But modern off-grid power systems typically operate at 24 or 48 VDC nominal. Higher voltage systems allow for smaller wiring between the DC charging sources and the batteries, and allow these charging sources to be farther away from the batteries.

High Quality Inverter

Twelve volts can be a great choice for small systems running some DC appliances, but 24 or 48 VDC nominal systems are far more common these days. That said, the inverter installed in our test system has performed flawlessly, and has definitely met my expectations.

You can choose from several high quality, battery-based inverters in the 1 to 2 kilowatt range. The Prosine 2.0 is definitely one of them. It is well suited for use in RVs, boats, and small off-grid systems.

Access

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